Any change in fuel composition which would provide the required octane ratings without alkyl lead additives would make possible lead-free exhaust. There is no national regulation in the United States limiting the quantity of alkyl lead additives in gasoline. However, there is a voluntary agreement between manufacturers of lead additives and the Public Health Service as to the maximum lead content of gasoline; this is at present 4.0 milliliters per gallon (TEL).

Evaporative losses from gas tanks and carburetors occur because these customarily have vents to the atmosphere. Evaporative losses from the carburetor are of two types, vent losses during vehicle operation, and what are called "hot soak" losses, which occur after the engine has been turned off and the rise in temperature of engine parts under the hood causes evaporation of gasoline stored in the carburetor bowl. Losses during vehicle operation have been substantially reduced during the last several years by the elimination of external vents from most carburetors. Those carburetors that vent externally do so during closed throttle operation to facilitate hot starting and to reduce fuel mixture enrichment during conditions of high temperature. An experimental system for control of "hot soak" losses pumps the fuel remaining in the carburetor bowl back to the gas tank after the engine has stopped. Since the bowl is empty when one wants to restart the car, there is an objectionable delay in starting which has to be overcome before this approach to control becomes acceptable. Such systems are not yet on production vehicles.

If there were no vent to allow air to enter the gas tank as fuel is consumed, tanks of normal construction would collapse because of the vacuum created inside; conversely, when the engine is off, a temperature rise would cause an increase in tank pressure. Since this tank overpressure is small, compared to the previously mentioned tank vacuum, a solution is the use of a one-way valve, which will let air into the tank but prevent vapor outflow over a moderate range of tank pressurization. The valve opens as a safety valve in the event of an overpressure high enough to impair the integrity of the tank. Such a valve, built as part of the gas tank filler cap, has been used experimentally and, in conjunction with insulation of the fuel tank, has been effective in reducing fuel tank evaporative losses. The safety, under accident conditions, of tanks so equipped has not been evaluated. This system is not in use on any American cars.

Another approach to the control of evaporative losses is through the reduction of the volatile components in the fuel. Studies are presently underway to determine the feasibility of this approach, both from the point of view of the effectiveness of control and of the effects on fuel characteristics.

The automotive pollution control measures so far described, Mr. Chairman, can be applied today or in the very near future. For the long haul, it would appear that add-on devices and minor engine modifications will ultimately fall short of the desired degree of abatement, so that research on fundamentally pollution free engines is also needed.

One means to achieve lean-mixture operation which results in more complete combustion and, therefore, in less pollution, is through the use of stratified charge techniques. Stratified charge operation presents to the spark plug at its firing time a small preliminary "starter dose" of rich fuel-air mixture which is easily ignited and propagates its flame to the rest of the fuel-air mixture, which might otherwise be too lean to be ignited by the spark plug. This method permits an excess of oxygen to be available for more complete combustion without affecting the efficiency of ignition. To achieve this type of operation, cylinder heads and combustion chambers would have to be redesigned.

The gas turbine engine is one of several potential alternatives to the conventional piston engine as a power source for motor vehicles. Chrysler Corporation, which is conducting extensive research and development in this field, made a prototype turbine car available for testing by the Public Health Service of this Department for a two-week period in April and May 1965.

The tests were focused mainly on the most common and best known classes of pollutants produced by internal combustion engines. They showed that hydrocarbon and carbon monoxide emissions from the turbine car were far lower than those from a comparable piston-engine model. In terms of pounds of pollutants per mile of driving, the turbine car emitted only 15 percent as much hydrocarbons and only 10 percent as much carbon monoxide. Nitrogen oxide emissions were also lower, but only slightly.

A potentially important advantage of the turbine car, with respect to air pollution, is its ability to burn low-grade, non-leaded, fuels, including kerosene.